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Abundance and Distribution of Stone's Sheep and Mountain Goats on the Russel Range, March 1993

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1.0 INTRODUCTION

Gathering information on the abundance and distribution of ungulates in the Williston Reservoir watershed was a key goal of the Peace/Williston Fish and Wildlife Compensation Program in the initial years of the program, particularly where management concerns were raised (Davidson and Dawson 1990). Consequently, when the Russel Range in the Finlay River drainage was identified as an area of special wildlife management concern in the late 1980s and subsequently identified as a candidate area for protected area status by the Ministry of Environment, Lands and Parks (D. King, MELP, personal communication), the PWFWCP proposed that a winter survey of the area be conducted.

A survey of the Russel Range had been conducted in the summer of 1985 (Watts and Child 1986a) but a winter survey was deemed warranted as the number and distribution of Stone's sheep (*Ovis dalli stonei*) and mountain goats (*Oreamnos americanus*) residing in the area during winter was poorly understood. Watts and Child (1986a) observed 398 Stone's sheep and 228 mountain goats during the July 1985 survey of the Russel Range. Child and King (1991) estimated that 625 to 900 Stone's sheep and over 1,500 mountain goats inhabit the Finlay River drainage[1], with Wildlife Management Unit 7-40 (the southern half represented by the Russel Range) supporting 400 to 550 sheep and approximately 400 goats.

The objectives of the Russel Range survey were to:

1. Determine the winter abundance, distribution, and sex and age structure of Stone's sheep.
2. Determine the winter abundance, distribution, and, if possible, sex and age structure of mountain goats.
3. Identify key areas used by Stone's sheep and mountain goats for potential enhancement and protection activities.
4. Record incidental sightings of other wildlife observed.

This report documents the findings of the March 1993 aerial survey of the Russel Range area.

[1] The Finlay River drainage, as described here, includes Wildlife Management Units 7-37 to 7-41.

2.0 SURVEY AREA AND WEATHER CONDITIONS

The survey area, consisting of the Russel Range and the southern tip of the Cormier Range, was situated in the Finlay River drainage of the Williston Reservoir watershed (Figure 1). The Russel Range represents the northeastern part of the Omineca Mountains. It is bordered on the west by Pelly Creek, on the east by the Finlay River, and extends northward from the Ingenika River to the major bend in the Finlay River located near the Obo River confluence (Figure 2). All but the southern portion (Ingenika River to Pelly Lake) of the Russel Range was surveyed. The small section of the Cormier Range (Cassiar Mountains) that was surveyed involved Prairie Mountain and Mount Bennett that lie along the northeast side of the Russel Range. The survey area encompassed approximately 950 km^2.

Both ranges lie within the Cassiar Mountains Ecosection and include the Alpine Tundra (AT) biogeoclimatic zone and the moist-cool Spruce-Willow-Birch (SWBmk1) subzone at higher elevations, with the dry-cool Boreal White and Black Spruce (BWBSdk) subzone located in the adjacent valley bottoms (Ministry of Environment, Lands, and Parks [MELP] 1998). Alpine areas are predominately situated above 1,600 m but some areas extend down to 1,500 m. Mountain peaks rise to 2,245 m, with most peaks between 1,830 m and 2,130 m in elevation. Both the Russel and Cormier Ranges are positioned in a southeast-northwest orientation. Bedrock within the survey area is comprised of limestones, quartzites, and highly metamorphosed schists (Holland, 1976).

Light winds and primarily clear, sunny skies characterised both days of surveying (9 and 10 March, 1993). Temperatures recorded in the morning for both days were around $-10^{o}C$. Ground snow-cover was complete except for steep south-facing escarpments and some windswept ridges being devoid of snow. No snow had fallen in the few days prior to the survey but fresh tracks were usually discernible.

3.0 METHODS

The aerial survey was conducted from a Bell 206 helicopter with a 3-person crew. The navigator (Mari Wood, PWFWCP) recorded the flight line and the location of animal groups observed on a 1:250,000 topographic map and also searched for and classified animals. The two rear-seat observers (Fraser Corbould, PWFWCP, and Peter Davidson, MELP) searched for, classified, and recorded animals observed.

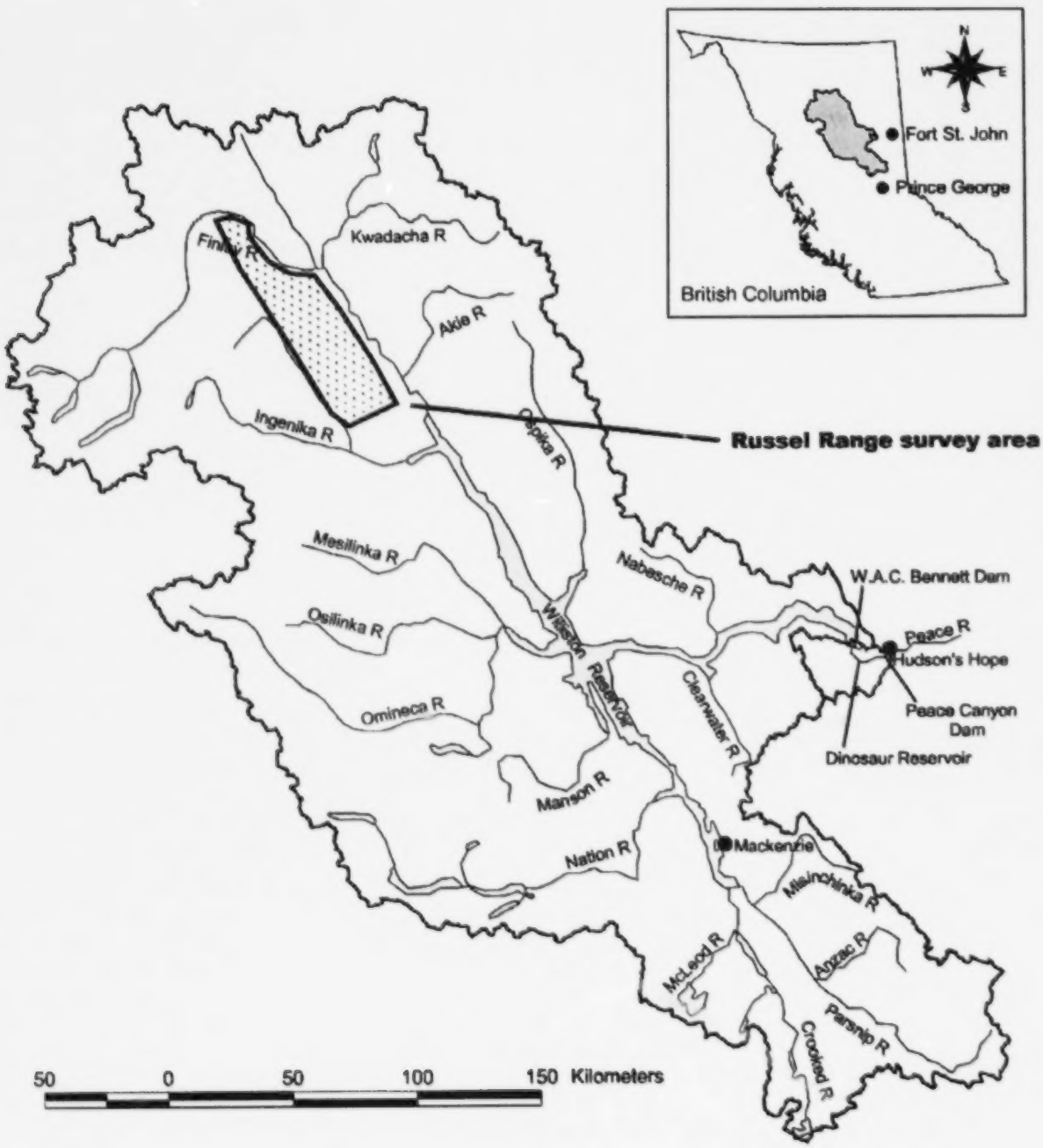

Figure 1. Russel Range survey area, Finlay River drainage, Williston Reservoir watershed.

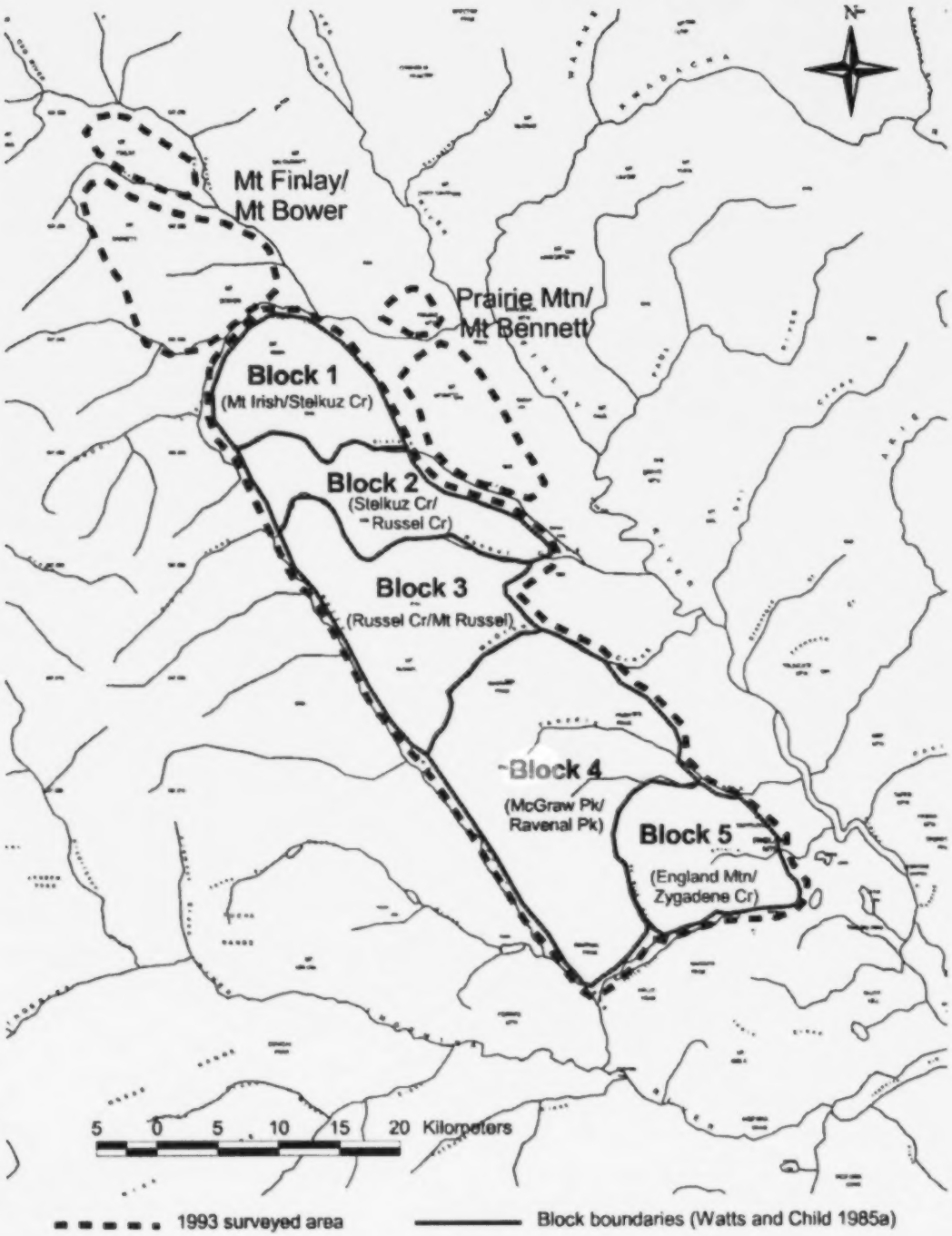

Figure 2. Survey areas and block delineations for Russel Range survey, 9 and 10 March 1993. Blocks 1 to 5 were also surveyed in the summer of 1985 (Watts and Child (1986a).

Due to financial and time constraints, alpine areas with a southerly aspect were the primary focus of the survey; alpine areas with a northern exposure were surveyed less intensively. Some lower elevation sites that contained potential escape terrain were also surveyed. Multiple flight-lines along ascending contour levels were flown when areas could not be completely observed by one pass. The first pass was flown just above treeline with subsequent passes at higher elevation contours until the area was adequately surveyed. Visibility was good and animal tracks in the snow were used to aid in locating animals. Survey airspeed was variable (approximately 110 to 160 km/hr) to ensure optimum sightability; airspeeds were typically slower along rock cliffs and faster along less severe habitat.

The number and classification of all Stone's sheep and mountain goats within each group were recorded. Stone's sheep were classified as rams, ewes, yearlings, and lambs. Rams were classified further on the basis of horn curl length: Class I [¼ curl], II [½ curl], III [¾ curl], and IV [full curl] (Geist, 1971). Mountain goats were similarly classified as best as possible to billies, nannies, unclassified adults and yearlings, and kids. Young of the year (lambs and kids) and yearlings were individuals considered to be 9 months and 21 months old respectively. The number and, where possible, classification of other wildlife incidentally observed were also recorded.

Animals that were located within approximately 200-300 m of one another were considered to be one group and were denoted on the map as one location. Typical group sizes (cf. Jarman 1974) were therefore not calculated as groups did not necessarily represent a discrete cluster of animals.

The surveyed area was estimated by calculating the area above the 1,500-m contour line on a 1:250,000 topographic map using a planimeter.

In order to compare the spatial distribution and composition between the winter 1993 and summer 1985 survey results, the Russel Range survey area was subdivided into five discrete alpine blocks as identified by Watts and Child (1986a; Figure 2),. Block numbers represented the following geographic areas, from north to south: Block 1 (Mount Irish to Stelkuz Creek), Block 2 (Stelkuz Creek to Russel Creek), Block 3 (Russel Creek to Mount Russel), Block 4 (McGraw Peak to Ravenal Peak), and Block 5 (England Mountain to Zygadene Creek). Additional areas surveyed in 1993, but not in 1985, were named based on their geographic location: Mount Finlay/Mount Bower and Prairie Mountain/Mount Bennett.

4.0 RESULTS

The survey was conducted between 08:00 and 18:00 hrs on 9 and 10 March 1993, with over 12 hours of search time being involved. The southern section (Zygadene Creek to Russel Creek) was surveyed in 7.5 hours on 9 March and the northern section (Russel Creek to Mt. Finlay and the Prairie Mtn./Mt. Bennett area) took 4.9 hours on 10 March, additional time was required to ferry to-and-from re-fuelling sites.

We observed 350 Stone's sheep and 211 mountain goats during the 2-day survey (Table 1 and 2). Sheep were found at 63 locations throughout most of the survey area, though they were not found east of Ed Bird Creek (Block 5), in the Mount Bennett/Prairie Mountain area, or north of Mt. Bower (Figure 3, Appendix A). Ten locations had 10 or more sheep present, with 24 sheep (group #87, Block 1) being the most sheep at any one location (Appendix A). The greatest numbers of sheep, representing over 85% of the observed population, were found in Block 1 (53 sheep), Block 3 (93), and Block 4 (157) (Table 1). Eighty rams -including 5 full-curl (class IV), 172 ewes, 47 yearlings, and 51 lambs were observed (Table 1). The adult (classes II-IV) and mature (classes III-IV) ram ratios were 34 and 16 per 100 adult females respectively (Table 3). Lambs were 30 per 100 adult females. The largest bachelor (adult rams) groups observed contained 6 rams: groups #24 (1-I, 4-II, and 1-III) and 62 (6-III) (Appendix A).

Mountain goats were also found throughout the survey area except for the Mt. Finlay/Mt. Bower and the Prairie Mtn./Mt. Bennett areas (Figure 3). Observers noted that the area north of Mt. Bower had more rolling terrain and more snow present. Goats were found at 51 different locations, with over 90% (197 goats) of the goats located in Block 2 (24%), Block 3 (29%), and Block 4 (40%). An attempt was made to classify yearling goats from the adult population during the survey but, due to the lack of confidence in their classification, yearlings were grouped with unclassified adults. Twenty-six billies, 101 nannies, 41 unclassified adults, and 43 kids were observed. The observed kid to adult (1+ years old) ratio was 26 kids per 100 adults. An adult male to adult ratio was not calculated as the number of unclassified adult goats was relatively high (41 of 168 adults).

Goats were observed at the same location as sheep on 14 occasions (Figure 3) and, in a few instances, individuals from both species were found in very close proximity (<3 m) to one another. The most animals (sheep and goats) at any one location was 33 found at group #40, west side of Block 4: 14 sheep and 19 goats.

Table 1. Abundance, distribution, and classification of Stone's sheep observed during an aerial survey of the Russel Range survey area, 9 and 10 March 1993.

Location	Block	No. of Groups	Rams[1]					Ewes	Yearlings				Lambs	Total
			I	II	III	IV	Total		M	F	UY[2]	Total		
Mt Finlay/Mt. Bower		2				2	2	7	4	2		6	3	18
Prairie Mtn./Mt. Bennett														0
Mt. Irish/Stelkuz Cr.	1	6	3	5	1		9	28	5	4		9	7	53
Stelkuz Cr./Russel Cr.	2	8	2	5	2		9	10	4	1		5	5	29
Russel Cr./Mt. Russel	3	21	5	8	12	1	26	46	4	4		8	13	93
McGraw Pk./Ravenal Pk.	4	26	11	14	7	2	34	81	8	8	3	19	23	157
England Mtn./Zygadene Cr.	5													0
TOTAL		63	21	32	22	5	80	172	25	19	3	47	51	350

[1] Ram classification: I [¼ curl], II [½ curl] III [¾ curl], IV [full curl] (Geist 1971).

[2] UY - unclassified yearling.

Table 2. Abundance, distribution, and classification of mountain goats observed during an aerial survey of the Russel Range survey area, 9 and 10 March 1993.

Location	Block	No. of Groups	Billies	Nannies	UA[1]	Kids	Total
Mt Finlay/Mt. Bower							0
Prairie Mtn./Mt. Bennett							0
Mt. Irish/Stelkuz Cr.	1	3		6		2	8
Stelkuz Cr./Russel Cr.	2	11	6	21	11	13	51
Russel Cr./Mt. Russel	3	15	8	33	6	15	62
McGraw Pk./Ravenal Pk.	4	21	12	36	24	12	84
England Mtn./Zygadene Cr.	5	1		5		1	6
TOTAL		51	26	101	41	43	211

[1] UA - unclassified adult (males and females 1+ years old).

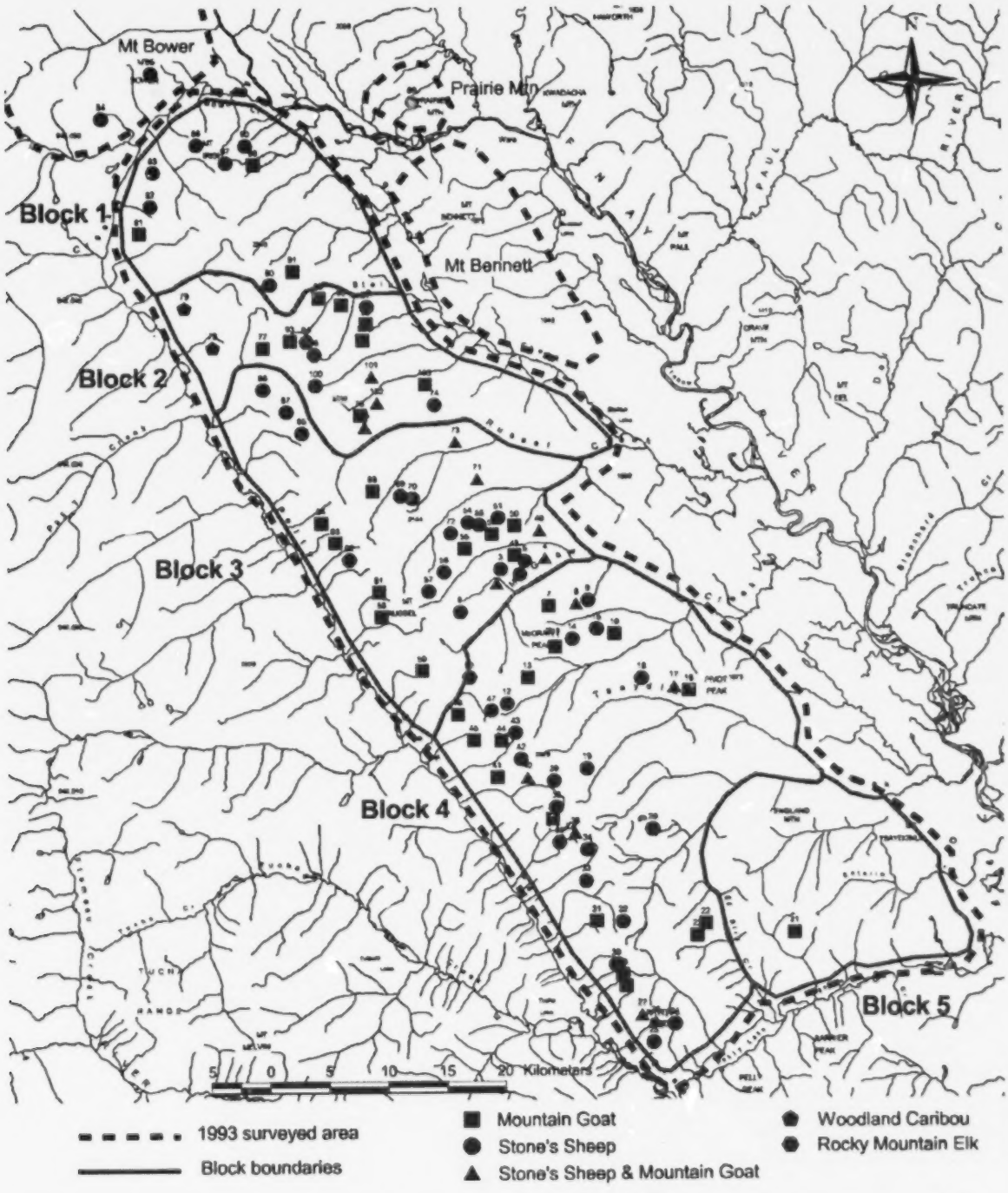

Figure 3. Locations of ungulate groups (Stone's sheep, mountain goats, woodland caribou, and Rocky Mountain elk) observed during an aerial survey of the Russel Range area, 9 and 10 March 1993. Blocks surveyed in the summer of 1985 are also identified (Watts and Child 1986a).

Table 3. Sex and age composition of Stone's sheep and mountain goats observed during an aerial survey of the Russel Range survey area, 9 and 10 March 1993.

Species & Age/Sex Category	Composition Ratios
Stone's sheep	
Adult males (Classes II-IV)	34 : 100 adult females[1]
Mature males (Classes III-IV)	16 : 100 adult females
Proportion of males in mature category	34%
Yearlings	27 : 100 adult females
Lambs	30 : 100 adult females
Mountain goat	
Kids	26 : 100 adults[2]

[1] Sheep: adult females (2+ years old)

[2] Goats: adults (males and females 1+ years old)

Stone's sheep and mountain goat density estimates for the Russel Range, based on observed populations and the area above 1,500 m in elevation, are 0.37 sheep/km^2 and 0.22 goats/km^2.

Incidental wildlife sightings during the survey included woodland caribou (*Rangifer tarandus*), Rocky Mountain elk (*Cervus canadensis nelsoni*), and wolves (*Canis lupus*). Caribou were observed in two groups in the northwest corner of Block 2: 17 caribou (5 bulls, 11 cows, and 1 calf) and 9 caribou (3 bulls, 6 cows) (Appendix A). Five elk (2 cows, 1 yearling, and 2 calves) were located on Prairie Mountain, northwest of Fort Ware. Two wolves were observed feeding on a Stone's sheep kill in the alpine near Mt. Irish (northeast corner of Block 1). Tracks in the snow indicated that the wolves had chased the sheep off of a rock outcropping and killed it in a small alpine bowl.

5.0 DISCUSSION

In 1985, a summer survey of the Russel Range was conducted in which 398 Stone's sheep and 204 mountain goats were observed in Blocks 1 to 5 (Table 4; Watts and Child 1986a). For the same area surveyed in 1993, 332 sheep and 211 goats were counted. Along with 66 fewer sheep being observed in 1993, there was also a shift in their prevalence (±50 sheep approximately) within Blocks 2, 3, and 4. More sheep were observed in the southern area (Block 4) during the 1993 winter survey. Sizeable numbers (>50) of sheep used areas within Blocks 1 through 4 for at least part of the year.

Table 4. Abundance and distribution of Stone's sheep and mountain goats observed during surveys of the Russel Range (Blocks 1 to 5 only) in July 1985 and March 1993. July 1985 survey results are from Watts and Child (1986a).

		Stone's Sheep[1]							Mountain Goats[2]				
		Rams											
Block	Year	I	II	III	IV	UA	Lambs	Total	Billies	Nannies	UA	Kids	Total
1	1985	1	12	3		32	7	**55**	2	1	3	1	**7**
	1993	3	5	1		37	7	**53**		6		2	**8**
2	1985	3	11	12	5	35	13	**79**	5	5	42	18	**71**
	1993	2	5	2		15	5	**29**	6	21	11	13	**51**
3	1985	1	13	8	9	87	40	**158**	14	19	11	14	**58**
	1993	5	8	12	1	54	13	**93**	8	33	6	15	**62**
4	1985	6	14	11	12	47	13	**106**	11	6	30	18	**65**
	1993	11	14	7	2	100	23	**157**	12	36	24	12	**84**
5	1985							**0**	1	1		1	**3**
	1993							**0**		5		1	**6**
Total	1985	11	50	34	26	204	73	**398**	33	33	86	52	**204**
	1993	21	32	22	3	206	48	**332**	26	101	41	43	**211**

[1] Sheep classification: Class I (¼ curl), II (½ curl) III (¾ curl), IV (full curl) rams; UA (unclassified adult; includes adult females [2+ years old], yearlings and, for 1985, 3 unclassified rams).

[2] Goat classification: UA (unclassified adult [1+ years old])

The difference in the observed Stone's sheep population from 1985 to 1993 is possibly attributable to a couple of factors: survey timing and a reduced ram component (hunting pressure and/or missed animals). Firstly, biases due to survey timing may account for some of the disparity in numbers. There were 25 more lambs observed in 1985 than in 1993 (Table 4). If the base population of sheep (i.e., early spring prior to lambing) on the Russel Range is approximately equal for both years, which it appears to be based on the non-ram component (ewes and yearlings) being relatively equal, the annual mortality to the 1985 lamb cohort would not have occurred to the same extent as to when the 1993 winter survey took place. Mortalities in sheep (*Ovis* spp.) are generally greatest in the youngest cohorts (Hoefs 1984, Festa-Bianchet 1989) with many of these deaths occurring in the winter period when food resources are reduced and weather conditions are more severe (Seip 1983, Heimer and Watson 1982, Nichols 1978, Luckhurst 1973). A lamb:adult female ratio, to help compare the lamb component between years, could not be calculated for 1985 due to the yearlings and adult females not being differentiated from one another (Watts and Child 1986a). However, a very conservative estimate (using unclassified adults comprised of yearlings and adult females) gives a ratio of more than 35 lambs per 100 unclassified adults for 1985, thus indicating a higher lamb component in the population during the 1985 survey than found in 1993 (23 lambs:100 unclassified adults and 30 lambs:100 females). The difference in animal sightabilty between the summer and winter surveys should not substantially bias the number of animals observed as the survey methodology was the same (e.g., contour-flying helicopter surveys of alpine habitats) and, if there was a bias, it would favour the winter survey as it is the preferred timing for Stone's sheep surveys (Resource Inventory Committee 1997).

Secondly, the lower numbers of sheep observed may be due to an under-representation of rams in the 1993 observed population. Adult rams (class II-IV) are particularly under-represented as they had 12 to 23 less animals in each of their classes (Table 4). Since natural mortality rates for adult mountain sheep are characteristically low (Seip 1983, Geist 1971), the small number of class IV rams observed in 1993 (3 compared to 26 in 1985) suggests that hunting may have played a role in the lower number of full-curl rams observed. Prior to the 1993 survey, 8 class IV rams were harvested during the annual fall hunt (MELP, unpublished data). Also, after the 1985 survey, which identified twice as many sheep as originally estimated for setting harvest regulations, an open season for resident hunters was initiated (Watts and Child, 1986a) and the local guide's quota was increased slightly (Glen Watts, MELP, personal communication). Between 1975 and 1985, resident hunters through a Limited Entry Hunting season and guided non-resident hunters harvested less than 5 class IV rams per year on average (μ_{pre} = 4.5 rams/yr, σ_{pre} = 1.3 rams/yr, n_{pre} = 11; Figure 4; MELP, unpublished data). With the more liberal hunting

season, over 9 rams per year on average were harvested from 1986 to 1992 (μ_{post} = 9.3 rams/yr, σ_{post} = 3.4 rams/yr, n_{post} = 7), mainly due to resident hunters. A re-assessment of the sheep harvest and better determination of ram numbers may be warranted to ensure that the harvest level is appropriate.

The liberalisation of hunting, however, does not account fully for the lower numbers of class II and III rams, which were not hunted. Murphy *et al.* (1990) found that the harvesting of mature rams does not affect the survival of younger rams or the production of lambs and yearlings for Dall sheep (*O. d. dalli*) in Alaska. Rams typically show spatial segregation from nursery groups (Shackleton 1999, Geist 1971) and thus some rams, possibly in bachelor groups, may have used other suitable wintering sites (e.g., lower elevation sites or adjacent ranges) that were not surveyed in 1993. Additional sheep were observed in 1993 around Mt. Bower, north of Block 1, but of the18 animals found only two were rams (both full curl) and the area was not surveyed in 1985, so similar numbers of sheep may have also been present there in 1985.

Although actual densities were not provided, the highest Stone's sheep densities in British Columbia are reported to be in the Muskwa and Kechika River drainages and portions of the Stikine River watershed in northern BC (Shackleton 1999, Elliott 1985). Shackleton describes the Russel Range as having a "moderate" density whereas Elliott stated that the Russel Range area, including ranges to the west, has "few to very few sheep". The low rating likely stands true for areas west of the Russel Range as summer surveys of the Fishing, Swannell, Wrede, Ingenika, and Lay Ranges recorded less than 60 sheep for an area encompassing more than 1,000 km^2 (Watts and Child 1986b, Watts 1990). Similarly, east of the Russel Range within the Williston Reservoir watershed, winter ungulate surveys conducted on the Muskwa Range indicate fewer than 20 sheep for large tracts of alpine habitat (Wood 1994, Ritchie 1991). It is evident, therefore, that the Russel Range supports a significant Stone's sheep population on a year-round basis and at densities nearing those in the Muskwa and Kechika River drainages (J. Elliott, MELP, personal communication). It is believed that the Russel Range, comprised of limestone and associated foliated metamorphic rocks (Young and Alley 1978), provides a more suitable habitat than the more volcanic geology to the west (Watts and Child, 1986b).

The only other notable numbers of Stone's sheep within the Williston Reservoir watershed is east of the Rocky Mountains on the north side of the Peace Reach, Williston Reservoir. An estimated 65 to 158 Stone's sheep are reported between the Nabesche River and Butler Ridge (Wood, in prep).

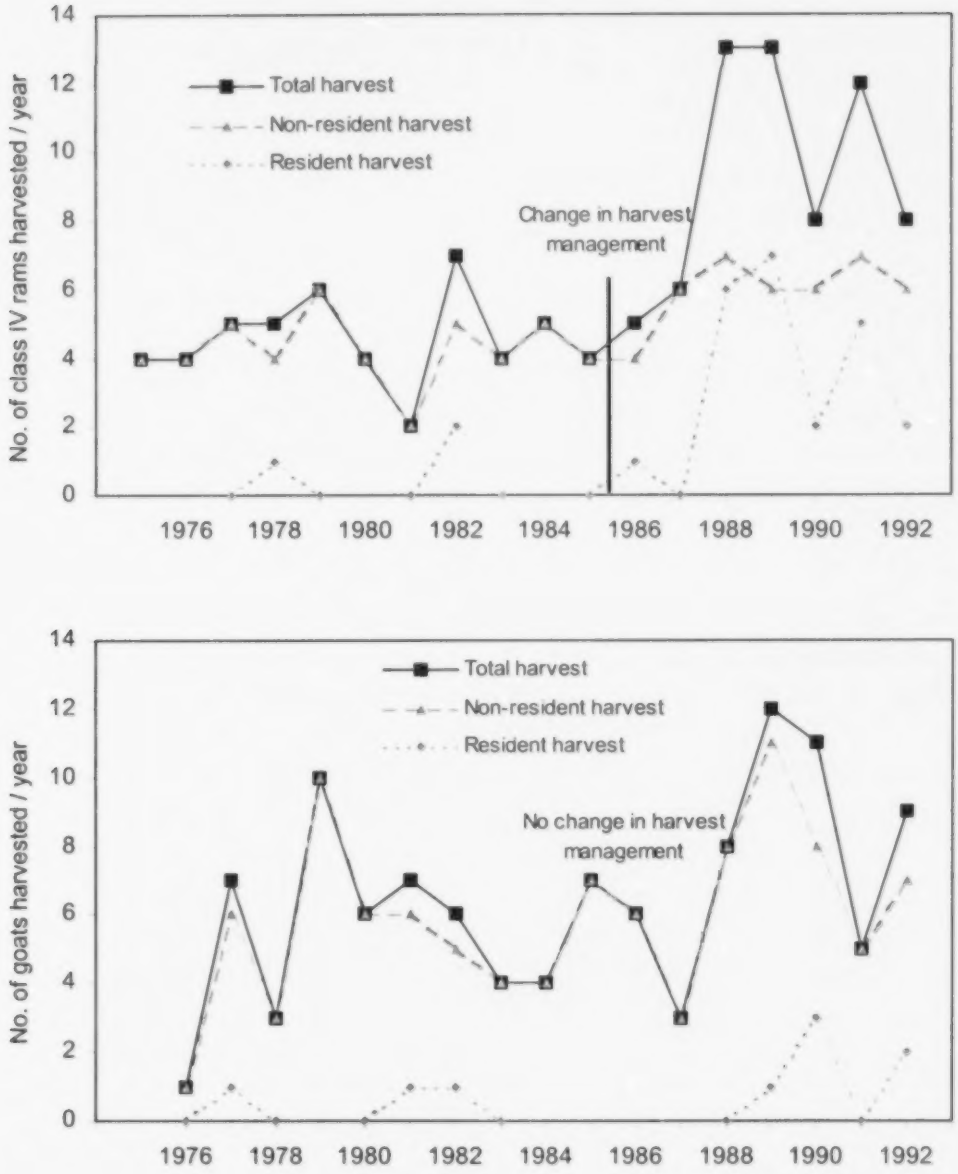

Figure 4. Harvest of class IV (full curl) Stone's sheep rams and mountain goats on the Russel Range, 1975 to 1992 (Ministry of Environment, Lands and Parks, unpublished data). Total harvest includes animals killed by resident (Limited Entry Hunt or open season) and guided non-resident hunters.

Mountain goat numbers were approximately the same for both survey years and there was only a minor shift in their distribution; Blocks 2 through 4 still contained over 90% of the observed goat population (Table 4). The 1985 survey was reported to roughly double the estimated goat population on the Russel Range but no changes were made to their harvest management as an open season for both resident and non-resident hunters already existed (Glen Watts, MELP, unpublished data). The increased harvesting pressure on Stone's sheep did not appear to affect the average harvest rate of goats as the number of goats killed remained fairly variable before and after the change in the sheep harvest (μ_{pre} = 5.5 goats/yr, σ_{pre} = 2.4 goats/yr, n_{pre} = 10; μ_{post} = 7.7 goats/yr, σ_{post} = 3.0 goats/yr, n_{post} = 7; Figure 4; MELP, unpublished data) and the resident harvest did not show a large increase. The lack of confidence in classifying adult goats (1+ years old) eliminated any potential for comparing the composition results for the two surveys other than for kids. And, similar to the Stone's sheep lamb numbers, kids were more prevalent in the 1985 summer survey than the 1993 winter survey, which could possibly be accounted for by the survey timing (i.e., higher mortality of kids in 1993 due to the additional difficulties of winter).

Relative to other provincial mountain goat populations, Shackleton (1999) indicates that goats throughout the Finlay River drainage have "moderate" densities, except for the southeastern portion of the Omineca Mountains (includes Block 5 and the area south to the Ingenika River) that is designated as "few". Based on these surveys, the density on the Russel Range, Blocks 2 through 4 specifically, is likely at the upper end of "moderate" or higher.

During the 1993 winter survey, mountain goats were found on several occasions in close proximity to Stone's sheep, sometimes within a few metres. Yet, during the 1985 summer survey, Watts and Child (1986a) state that no goats were found in the "immediate vicinity" of sheep. Winter conditions likely reduce the availability of suitable habitats and, hence, force these species into closer proximity.

As part of the Mackenzie Land and Resource Management Plan, established to direct the planning and management of land and resource activities in the Mackenzie Forest District, the Finlay-Russel Protected Area (PA) was established in 2000 (Province of BC 2000). The Finlay-Russel PA encompasses the northwestern portion of the Russel Range (area along the west side from Mt. Russel to west of the Stelkuz Creek headwaters and the area north of the Stelkuz Creek drainage) and continues north-westward along the Finlay River. Consequently, all of Block 4 and the eastern side of Blocks 2 and 3, that provide a significant proportion of the area used by sheep and goats, are not included in the Finlay-Russel PA.

Therefore, in order to ensure the long term maintenance and conservation of these populations, consideration of these species should be an integral part of future land and resource management decisions as development activities occur in the area.

In an attempt to increase the availability of forage for sheep and goats on the Russel Range, high elevation sites adjacent to suitable escape terrain could be enhanced by prescribed burning. Potential sites, subject to further assessment for their enhancement feasibility, include the southern slopes along the east-west ridges near McGraw Peak and Mt. Russel; the southern and western slopes near Ravenal Peak; and the southern slopes near Mt. Bower and Mt. Irish.

6.0 SUMMARY

Similar numbers of yearling and adult female Stone's sheep observed in 1985 and 1993 and a relatively good lamb:ewe ratio in 1993 suggest that the sheep population on the Russel Range is likely stable. However, the adult ram component was underrepresented in 1993 and may be a result of increased hunting pressure on full-curl rams (class IV) and/or missed individuals (e.g., bachelor groups). The Russel Range mountain goat population appears to be stable.

The Russel Range supports one of the largest Stone's sheep populations in the Williston Reservoir watershed and yields a substantial goat population as well. Both species had their greatest proportion of animals inhabiting the area between Stelkuz Creek and Ravenal Peak. The relative density of Stone's sheep on the Russel Range is likely higher than reported in the provincial literature.

7.0 ACKNOWLEDGEMENTS

I would like to thank Mari Wood (PWFWCP) for planning and helping conduct the survey, and for reviewing an earlier draft of the report. Also, thanks go to Peter Davidson (MELP, Fort St. John) for helping conduct the survey and for his expertise in classifying Stone's sheep. The helicopter was chartered from Northern Mountain Helicopters (Prince George) and was piloted by Blair Savage.

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APPENDIX A: Abundance and classification of ungulates (Stone's sheep, mountain goats, woodland caribou, and Rocky Mountain elk) observed during an aerial survey of the Russel Range, 9 and 10 March 1993.

Area	Group No.	UTM coordinates Zone	Easting	Northing	Block	Species Composition	Stone's Sheep Male Yrlg	Male I	Male II	Male III	Male IV	Female Adult	Female Yrlg	Uncl Yrlg	Lamb	Total	Mountain Goat Adult Male	Adult Female	Adult Uncl	Yearling M	Yearling F	Yearling Uncl	Kid	Total	Caribou Male	Female	Calf	Total	Elk Cow Bull	Cow Ad	Cow Yrlg	Calf	Total
Russel Cr./Mt. Russel	1	10	340200	6337400	3	S						4			1	5								0				0					0
Russel Cr./Mt. Russel	2	10	338600	6336800	3	S & G						1				1			2					2				0					0
Russel Cr./Mt. Russel	3	10	338900	6337800	3	S						2				2								0				0					0
Russel Cr./Mt. Russel	4	10	342000	6338400	3	S & G						5			1	6			1					1				0					0
Russel Cr./Mt. Russel	5	10	340800	6338300	3	S						1				1								0				0					0
Russel Cr./Mt. Russel	6	10	336000	6335000	3	S			1	1		3				5								0				0					0
McGraw Pk./Ravenal Pk	7	10	340100	6335100	4	G										0				1				1				0					0
McGraw Pk./Ravenal Pk	8	10	344000	6335250	4	S & G						2				2	2	1	1			1		5				0					0
McGraw Pk./Ravenal Pk	9	10	344800	6335400	4	S		2	1	1		11			5	20								0				0					0
McGraw Pk./Ravenal Pk	10	10	346500	6333000	4	G										0		2					1	3				0					0
McGraw Pk./Ravenal Pk	11	10	342400	6332300	4	G										0		3			1		1	5				0					0
McGraw Pk./Ravenal Pk	12	10	338900	6328600	4	S			1			1			1	3								0				0					0
McGraw Pk./Ravenal Pk	13	10	340400	6330300	4	G										0		5				1	3	9				0					0
McGraw Pk./Ravenal Pk	14	10	343600	6332800	4	S						1			1	2								0				0					0
McGraw Pk./Ravenal Pk	15	10	345300	6333400	4	S		2		1	1					4								0				0					0
McGraw Pk./Ravenal Pk	16	10	351400	6328900	4	G										0		1				1		2				0					0
McGraw Pk./Ravenal Pk	17	10	350400	6329200	4	S & G		1		1		5			1	8			1					1				0					0
McGraw Pk./Ravenal Pk	18	10	348200	6329900	4	S			1			9	2		2	14								0				0					0
McGraw Pk./Ravenal Pk	19	10	344200	6329800	4	S		1				5		1		7								0				0					0
McGraw Pk./Ravenal Pk	20	10	348500	6319600	4	S						3	1		1	5								0				0					0
England Mtn./Zygadene Cr.	21	10	357800	6312100	5	G										0		5					1	6				0					0
McGraw Pk./Ravenal Pk	22	10	351800	6313000	4	G										0	1	2			1			4				0					0
McGraw Pk./Ravenal Pk	23	10	351200	6312200	4	G										0			1					1				0					0
McGraw Pk./Ravenal Pk	24	10	349400	6308300	4	S		1	4	1						6								0				0					0
McGraw Pk./Ravenal Pk	25	10	347900	6305100	4	S						6	1		1	8								0				0					0
McGraw Pk./Ravenal Pk	26	10	348100	6306500	4	S & G						6				6						1		1				0					0
McGraw Pk./Ravenal Pk	27	10	347250	6307000	4	S & G		1						1		2		4					1	5				0					0
McGraw Pk./Ravenal Pk	28	10	346250	6309000	4	G										0			1					1				0					0
McGraw Pk./Ravenal Pk	29	10	346000	6309800	4	G										0	2	2						4				0					0
McGraw Pk./Ravenal Pk	30	10	345600	6310500	4	S	2	1	1			1			1	6								0				0					0
McGraw Pk./Ravenal Pk	31	10	344400	6313500	4	G										0		4	1			2	1	8				0					0
McGraw Pk./Ravenal Pk	32	10	346200	6313400	4	S	1		1			8	1		2	13								0				0					0
McGraw Pk./Ravenal Pk	33	10	343800	6316300	4	S						1				1								0				0					0
McGraw Pk./Ravenal Pk	34	10	344000	6318400	4	S			1			8	1	1	1	12								0				0					0
McGraw Pk./Ravenal Pk	35	10	342100	6319000	4	S	1					2			1	4								0				0					0
McGraw Pk./Ravenal Pk	36	10	343250	6319600	4	S & G		1		1						2			3					3				0					0
McGraw Pk./Ravenal Pk	37	10	341700	6320600	4	G										0		1	1					2				0					0
McGraw Pk./Ravenal Pk	38	10	342000	6321400	4	S	1		3				1			5								0				0					0
McGraw Pk./Ravenal Pk	39	10	341900	6323250	4	S						3			1	4								0				0					0
McGraw Pk./Ravenal Pk	40	10	340100	6323500	4	S & G	3	1	1	1	1	3	1		3	14	5	7	2			1	4	19				0					0
McGraw Pk./Ravenal Pk	41	10	338000	6323600	4	G										0				1				1				0					0
McGraw Pk./Ravenal Pk	42	10	339700	6324800	4	S						2			2	4								0				0					0
McGraw Pk./Ravenal Pk	43	10	339400	6326600	4	S						2				2								0				0					0
McGraw Pk./Ravenal Pk	44	10	338400	6326100	4	G										0			1					1				0					0
McGraw Pk./Ravenal Pk	45	10	338500	6326200	4	G										0	2	2				1		5				0					0
McGraw Pk./Ravenal Pk	46	10	335500	6328000	4	G										0		2					1	3				0					0
McGraw Pk./Ravenal Pk	47	10	337800	6328250	4	S						2				2								0				0					0
Russel Cr./Mt. Russel	48	10	339900	6338700	3	G										0		2					1	3				0					0
Russel Cr./Mt. Russel	49	10	341700	6340300	3	S & G	1					5			2	8	1	3			1	1	2	8				0					0
Russel Cr./Mt. Russel	50	10	340000	6340700	3	G										0		1			1		1	3				0					0
Russel Cr./Mt. Russel	51	10	338900	6341300	3	S		1				4			1	6								0				0					0
Russel Cr./Mt. Russel	52	10	338400	6340200	3	G										0	2	1						3				0					0
Russel Cr./Mt. Russel	53	10	337600	6340900	3	S		1				5	1		3	10								0				0					0
Russel Cr./Mt. Russel	54	10	336800	6341100	3	S	1					1				2								0				0					0
Russel Cr./Mt. Russel	55	10	336500	6339300	3	G										0	2	1						3				0					0
Russel Cr./Mt. Russel	56	10	335000	6337800	3	S	1					1				2								0				0					0
Russel Cr./Mt. Russel	57	10	333900	6336500	3	S			2	2	1	1				6								0				0					0
Russel Cr./Mt. Russel	58	10	330600	6334900	3	G										0		2					1	3				0					0
Russel Cr./Mt. Russel	59	10	333200	6331100	3	G										0	1	2			1		1	5				0					0
McGraw Pk./Ravenal Pk	60	10	336400	6330500	4	S				1						1								0				0					0
Russel Cr./Mt. Russel	61	10	330500	6336800	3	G										0		6		1			5	12				0					0
Russel Cr./Mt. Russel	62	10	328600	6338900	3	S				6						6								0				0					0
Russel Cr./Mt. Russel	63	10	327700	6340100	3	G										0		3					1	4				0					0

Area	Group No	UTM coordinates Zone	Easting	Northing	Block	Species Composition	Stone's Sheep Male Yrlg	I	II	III	IV	Female Adult	Female Yrlg	Uncl Yrlg	Lamb	Total	Mountain Goat Adult Male	Adult Female	Adult Uncl	Yearling M	Yearling F	Yearling Uncl	Kid	Total	Caribou Male	Caribou Female	Caribou Calf	Caribou Total	Elk Bull	Elk Cow Ad	Elk Cow Yrlg	Elk Calf	Elk Total
Russel Cr /Mt. Russel	64	10	326800	6341500	3	G										0			2					2				0					0
Russel Cr /Mt. Russel	65	10	325800	6347700	3	S			1	1						2								0				0					0
Russel Cr /Mt. Russel	66	10	323300	6350800	3	S						2	1		1	4								0				0					0
Russel Cr /Mt. Russel	67	10	324800	6349200	3	S	1	1	2			4			2	10								0				0					0
Russel Cr /Mt. Russel	68	10	330400	6343500	3	G										0	1	4					3	8				0					0
Russel Cr /Mt. Russel	69	10	332300	6343100	3	S		2	1	1		1	1			6								0				0					0
Russel Cr /Mt. Russel	70	10	333100	6342900	3	S			1			2			1	4								0				0					0
Russel Cr /Mt. Russel	71	10	337800	6344000	3	S & G						1			1	2		3						3				0					0
Russel Cr /Mt. Russel	72	10	335600	6340400	3	S						2				2								0				0					0
Russel Cr /Mt. Russel	73	10	336200	6346800	3	S & G				1		1	1			3	1		1					2				0					0
Stelkuz Cr /Russel Cr	74	10	334900	6349200	2	S	1	1				2			1	5								0				0					0
Stelkuz Cr /Russel Cr	75	10	330100	6347900	2	S & G			2							2		3					2	5				0					0
Stelkuz Cr /Russel Cr	76	10	329800	6348700	2	G										0		1	1					2				0					0
Stelkuz Cr /Russel Cr	77	10	323400	6353800	2	G										0	3	5				1	4	13				0					0
Stelkuz Cr /Russel Cr	78	10	320000	6353800	2	C										0								0	5	11	1	17					0
Stelkuz Cr /Russel Cr	79	9	679500	6356500	2	C										0								0	3	6		9					0
Mt. Irish/Stelkuz Cr	80	10	324100	6357900	1	S	3	1	1			13	2		1	21								0				0					0
Mt. Irish/Stelkuz Cr	81	9	675200	6361400	1	G										0		3						3				0					0
Mt. Irish/Stelkuz Cr	82	9	676900	6362300	1	S						2			1	3								0				0					0
Mt. Irish/Stelkuz Cr	83	9	677000	6365600	1	S			1	1						2								0				0					0
Mt. Finlay/Mt. Bower	84	9	673300	6369100		S	4					6	2		2	14								0				0					0
Mt. Finlay/Mt. Bower	85	9	676600	6372300		S					2	1			1	4								0				0					0
Mt. Irish/Stelkuz Cr	86	9	679900	6367800	1	S		1	1							2								0				0					0
Mt. Irish/Stelkuz Cr	87	10	321500	6366300	1	S	2	1	1			13	2		5	24								0				0					0
Mt. Irish/Stelkuz Cr	88	10	323400	6366100	1	G										0		1					1	2				0					0
Prairie Mtn./Mt. Bennett	89	10	334400	6369800		E										0								0				0		2	1	2	5
Mt. Irish/Stelkuz Cr	90	10	322900	6367400	1	S			1							1								0				0					0
Mt. Irish/Stelkuz Cr	91	10	325700	6358700	1	G										0		2					1	3				0					0
Stelkuz Cr /Russel Cr	92	10	327400	6356800	2	G										0		1		1				2				0					0
Stelkuz Cr /Russel Cr	93	10	325300	6354000	2	G										0		1	2				1	4				0					0
Stelkuz Cr /Russel Cr	94	10	326400	6353900	2	S			1	1						2								0				0					0
Stelkuz Cr /Russel Cr	95	10	328900	6356300	2	G										0	1	2				1	2	6				0					0
Stelkuz Cr /Russel Cr	96	10	329900	6353000	2	S	1	1				2			1	5								0				0					0
Stelkuz Cr /Russel Cr	97	10	330800	6356100	2	S						1			1	2								0				0					0
Stelkuz Cr /Russel Cr	98	10	330200	6353800	2	G										0			1					1				0					0
Stelkuz Cr /Russel Cr	99	10	332500	6354900	2	G										0		1						1				0					0
Stelkuz Cr /Russel Cr	100	10	328900	6350900	2	S	1		2	1		1			1	6								0				0					0
Stelkuz Cr /Russel Cr	101	10	330700	6351300	2	S & G						1	1			2	1	2	2				2	7				0					0
Stelkuz Cr /Russel Cr	102	10	331000	6349500	2	S & G	1					3			1	5	1	5		1			2	9				0					0
Stelkuz Cr /Russel Cr	103	10	334300	6350800	2	G										0			1					1				0					0
TOTAL							25	21	32	22	5	172	19	3	51	350	26	101	21	1	8	11	43	211	8	17	1	26	0	2	1	2	5

Area/Block Summary

Area	Block	UTM coordinates Zone	Easting	Northing	Block	Species Composition	Stone's Sheep Male Yrlg	I	II	III	IV	Female Adult	Female Yrlg	Uncl Yrlg	Lamb	Total	Mountain Goat Adult Male	Adult Female	Adult Uncl	Yearling M	Yearling F	Yearling Uncl	Kid	Total	Caribou Male	Caribou Female	Caribou Calf	Caribou Total	Elk Bull	Elk Cow Ad	Elk Cow Yrlg	Elk Calf	Elk Total
Mt Finlay/Mt. Bower							4				2	7	2		3	18																	
Mt. Irish/Stelkuz Cr	1						5	3	5	1		28	4		7	53		6					2	8									
Stelkuz Cr /Russel Cr	2						4	2	5	2		10	1		5	29	6	21	7		2	2	13	51	8	17	1	26					
Russel Cr /Mt. Russel	3						4	5	8	12	1	46	4		13	93	8	33	1	1	3	1	15	62									
McGraw Pk./Ravenal Pk	4						8	11	14	7	2	81	8	3	23	157	12	36	13		3	8	12	84									
England Mtn./Zygadene Cr	5																	5					1	6									
Prairie Mtn./Mt. Bennett																														2	1	2	5
TOTAL							25	21	32	22	5	172	19	3	51	350	26	101	21	1	8	11	43	211	8	17	1	26	0	2	1	2	5

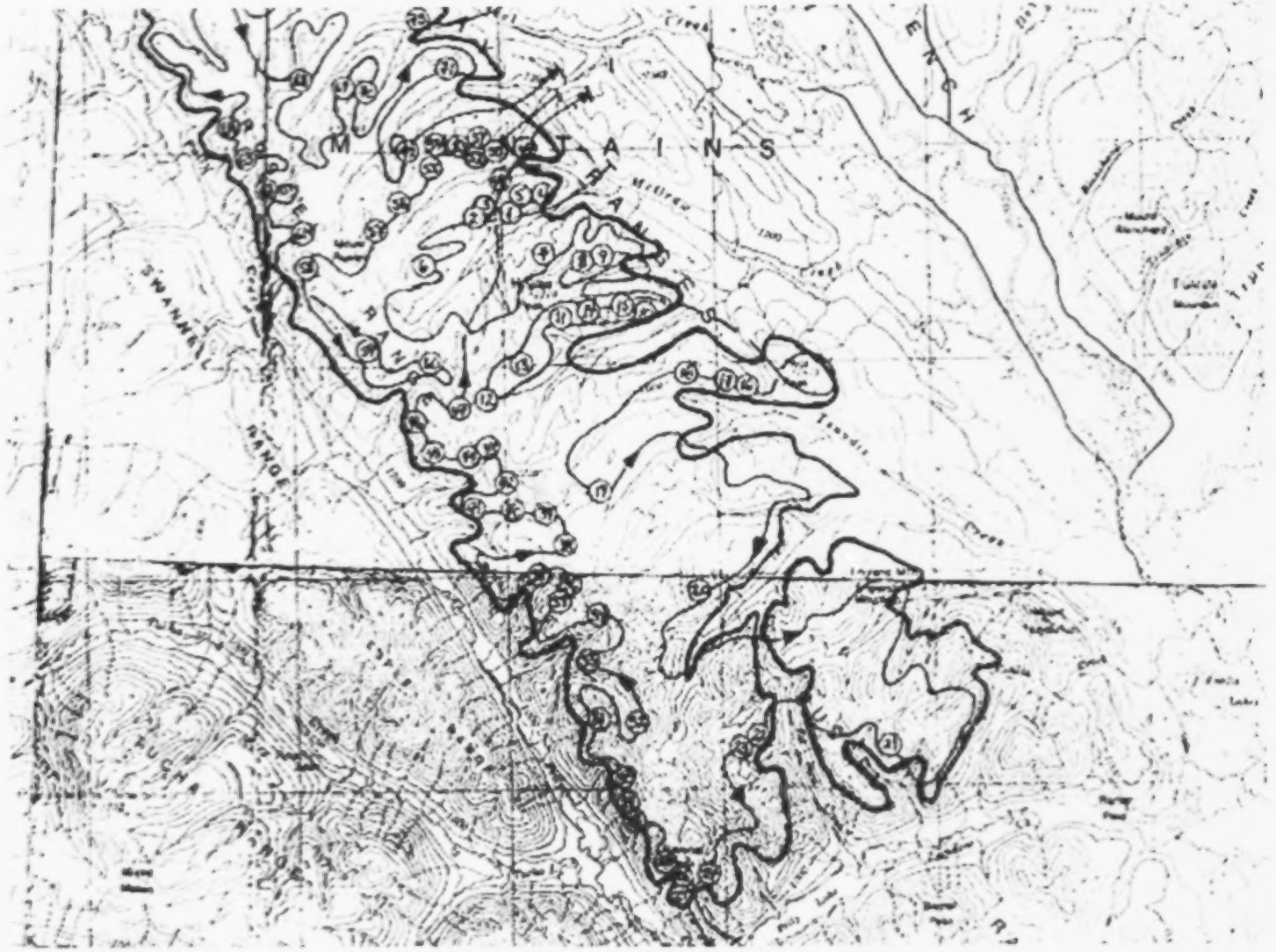
0

Sheep groups 63 Sheep (10+): 10

Goat groups 51 Goats (8+): 8

Sheep & goat groups 14

APPENDIX B: Survey area (northern and south sections) and ungulate group locations from an aerial survey of the Russel Range area, 9 and 10 March 1993. Flight line shows general direction of survey but does not indicate where multiple-contour flight passes occurred.


M O U N T A I N S
E N C H
SWANNANOA
RIVER
RD